Method and Device for Controlling the Movement of a Teeming Ladle Having a Lof Teeming Height in a Teeming Installation Device

BACKGROUND OF THE INVENTION

1. Field of the Invention.

The present invention relates to a method of controlling the movement of a teeming ladle and to a teeming machine for carrying out the method.

Existing automatic foundry installations for the repeated controlled filling of liquid metals from a tiltable ladle into successively furnished moulds function in the following manner: the molten mass during the teeming runs via a spout stone of radius R out of the ladle, wherein the tilting axis of the ladle extends at least approximately through the centre of this radius, the socalled theoretical point of rotation of the spout, such that independently of the tilting angle of the ladle approximately equal geometric and thus flow design relationships are to be achieved. The tilting is effected via a controlled drive which via mechanical connection members engages the ladle.

With such installations one achieves an excellent running of the teeming procedure when teeming, during the teeming and at the completion of this. However such installations suffer from the disadvantage for teeming at a relatively low teeming height the teeming funnel must lie near the edge of the mould box. With teeming funnels positioned further inside and whilst maintaining the required defined safety distance of the ladle body with respect to the mould box, the teeming height increases because of the segment shape of the teeming ladle.

Since teeming funnels positioned far inside the mould box may not be reached in a satisfactory manner, the funnel must be pulled to the edge which with existing models leads to costly modifications. In moulding boxes with weighting iron, the weighting iron must often be modified which again leads to additional costs. However since on the models or weighting irons, changes may not always be carried out, on account of the high teeming height one may only teem with an extended teeming spout. Such a teeming spout is however not suitable for the automatic teeming and with manual teeming can be handled only with difficulty.

From EP Patent 592 365 there is known a teeming method in which the teeming ladle, after the first teeming operation, and because of a stationary tilting axis may be displayed further towards the middle of the teeming mould, whilst maintaining a certain safety distance of the teeming ladle with respect to the teeming box. With this method the stationary tilting axis with the lift drive is attached at the front on the teeming spout and since the tilting bearing required on the tilting axis must likewise be located at a safety distance over the teeming box or the weighting iron, this leads by way of design likewise to a large teeming height. A large teeming height however causes considerable disadvantages; since more kinetic energy must be destroyed a deeper teeming funnel becomes necessary so that the top box may not be optimally exploited. Furthermore more circulation material is required, there is more splatter iron, a more erratic teeming with more turbulence in the funnel, and more sand rinsings and more sand and gas enclosures are to be expected. With mould boxes with weighting iron the teeming height is increased further since the tilting bearing must lie above the weighting iron.

BRIEF SUMMARY OF THE INVENTION

It is thus an object of the invention to avoid all mentioned

disadvantages and to provide a method and a teeming machine for controlling the movement of a teeming ladle, with which one may always teem at a lower teeming height even when the teeming funnels are arranged at any location in the mould box, and with which the theoretical point of rotation of the spout is stably guided into the lowest possible position. This object is achieved by the method and the teeming machine as hereinafter set forth in greater detail.

BRIEF DESCRIPTION OF THE DRAWINGS

Hereinafter, a preferred embodiment of the invention is described in more detail by way of the schematic drawings, in which:

Fig. 1 is a side elevational view of the teeming machine
Fig. 2 is a top elevational view of the teeming machine shown in Fig. 1,
Fig. 3 is a view of the teeming ladle in the teeming position and
Fig. 4 is a sketched detail of the teeming ladle suspension.

DETAILED DESCRIPTION OF THE INVENTION

According to Fig. 1 the teeming machine 1 on wheels 2 of a longitudinal carriage 3 is horizontally movable on rails 4 in a direction Y, parallel to a teeming mould path indicated at 5. The longitudinal carriage 3 supports a transverse carriage 6, which by way of rail guides 7 is transversely displaceable in a direction X by way of a friction motor 8. On the transverse carriage 6 there is mounted a tower-like structure of the teeming machine and its control cabin 10 with the electronic control means 11, with an intermediate arrangement of pressure fluid gauge chambers 12. In the structure 9, there is provided a retaining means 13 for the teeming ladle 14 for moving it up and down in the vertical direction Z. The retaining means 13 is suspended on a

chain 15 which is displaced via chain wheels 17 driven by a lift motor 16. In the retaining means 13 there is mounted a tilt shaft 18 which is rotatable about an axis A and which is driven by a tilt motor 19. The tilt shaft 18 pivots a protruding suspension plate 20 in which the teeming ladle 14 is suspendably fastened.

During operation of the teeming machine the longitudinal carriage 3 and the teeming ladle 14 filled with moulten metal mass is moved in the Y-direction until the teeming spout 21 at the height of the teeming funnel 22 is opposite the teeming mould 24 loaded with the weighting iron 23 and which is to be cast, which is effected by the electronic control means 11. The electronic control means 11 is provisionally programmed corresponding to the dimensions of the teeming moulds to be cast. According to the programm which is to be called up the friction motor 8, the lift motor 16 and the tilt motor 19 are controlled in a manner such that the theoretical point of rotation of the spout D with the radius R of the spout stone 25 moves on the curve K1 from above to below which always corresponds to the lowest possible teeming height whilst observing a safety distance. For this the engagement point K of the tilting moment transmitted by the tilt shaft 18 via the suspension plate 20 onto the teeming ladle 14 must move on the curve K2 correspondingly from bottom to top, which is effected by the suitable control of the mentioned motors.

By way of the pressure fluid gauge chambers 12 functioning as weighing cells the teeming procedure may be automatically stopped by the control means 11 in dependence on the cast molten mass weight and may be resumed with the subsequent teeming mould. With this the electronic control means is programmed such that the lifting and lowering of the teeming spout is carried out in the fast mode during the teeming pause which is to be kept as small as possible. Until the curves K1 and K2 are passed through and the teeming ladle is thus emptied, in general several teeming moulds may be

filled. With the empty teeming ladle the teeming machine must traverse to a loading and unloading station where the empty teeming ladle is replaced by one which is full. Thereupon after traversing back the teeming procedure may be reassumed. In order to avoid such a temporal interruption in teeming, two teeming machines may be arranged next to one another so that when the teeming ladle of the first teeming machine is empty the second immediately continues the teeming operation whilst the first one replaces the empty teeming ladle with a filled one. The only condition to this method is that the loading and unloading station can be reached in both directions of the rails 4.

With the protruding suspension plate 20 it is possible for the first time to fasten the teeming ladle only on one of its lateral surfaces and to tilt it. This is achieved with protruding coupling parts 26 and 27 on the teeming ladle, wherein the part 26 with a partially circular recess 28 engages into an axle stub 29 and the part 27 into an opening 30 of the retaining plate 20 by which means the teeming ladle is suspended on the retaining plate. For its lateral stabilisation the teeming ladle 14, with a rounded protrusion 31 below rests on a protruding part 32 of the suspension plate 20. With this suspension of the teeming ladle numerous advantagesresult, thus the teeming machine may be designed smaller, the accessibility between the teeming ladle and teeming mould is improved, only a vertical drive in the Z-direction and a tilting drive about the axis A is necessary, a rotational drive for exchanging the ladle is made possible, by which means this exchange is greatly accelerated and ladles of varying size may be applied.

The spout 21 of the teeming ladle 14 is equipped with an exchangeable spout stone 25. In this manner the stone may be kept smaller and more economical; it may be simply and quickly exchanged whenever a ladle is changed and fireprooof material is saved. The exact insertion of the spout stone is effected by a bracket mounted on the snout so that the radius of the spout stone on teeming moves exactly about the theoretical point of

rotation of the spout D, by which means teeming flow fluctuations during the complete tilting procedure are avoided.

For holding back the slag, for breaking the waves and for absorbing the kinetic energy arising in the ladle by way of the tilting in the vicinity of the spout 21 there is applied a specially formed slag brick 33.

With the described teeming machine practically each and every cast object may be teemed regardless of the height of an associated mould box, since with a model change the electric control means have to be appropriately reprogrammed to match the curves K1 and K2 to the new model.